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ANOPHELINES OF THE AMAZON VALLEY.<sup>1</sup>

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I.

INTRODUCTION.

The following is an account of the anophelines collected during a general mosquito survey made in the Amazon Basin between the latter part of March to the end of June, 1931. Collections were made chiefly at Iquitos, Peru; Porto Velho, Rio Madeira; Manáos, Rio Negro; and Boa Vista (Fordlandia), Rio Tapajos. The period of the survey corresponds roughly to the latter part of the rainy season, presumably one of the most favorable periods for mosquito life in the valley. The more interesting results of the survey are:

1. Fourteen species were found, one-half of the known anopheline fauna of Brazil.

2. No new species were discovered, although important material was obtained of seven species that are little known.

3. All of the species found belong to the "lowland" and "open country" groups. The "upland" breeders apparently do not exist here or else have a very localized distribution.

4. The absence of *An. argyritarsis*<sup>2</sup> is the most surprising omission in the fauna, especially as this species is, in general, one of the commonest and most widely spread of the South American anophelines. Also, the typical form of the equally common and widely distributed *An. albitarsis* was found only along the periphery of the basin, although its variety, *brasiliensis*, was found in a restricted locality at Manáos.

<sup>1</sup> The studies and observations on which this paper is based were conducted with the support and under the auspices of the International Health Division of the Rockefeller Foundation. The writer is indebted to officials of the U. S. National Museum and U. S. Bureau of Entomology for permission to examine the collection of *Culicidae* in their custody; and to Dr. Harvey Bassler, formerly of Iquitos, for his friendly advice and assistance at Iquitos. He is likewise indebted to Mr. Clarence Rogge and Dr. Claude Smith, of Fordlandia, and to Sr. R. de Mello, of Manáos, for similar courtesies.

<sup>2</sup> The species heretofore recorded as *An. argyritarsis* from the Amazon region is, in all probability, *An. darlingi*.

5. Five species were fairly common locally. Nowhere, however, were anophelines found in such great densities as is commonly attained by *quadrimaculatus*, *maculipennis*, and *elutus* in certain regions of the north temperate zone.

6. Only one species, *An. darlingi*, was found in houses in appreciable numbers; others (*mattogrossensis*, *bachmanni*, *tarsimaculatus*, and *albitarsis*) were seen only occasionally.

7. *An. darlingi* doubtlessly is the most important vector of malaria in Amazonia. The evidence obtained during the trip indicates that it is primarily a flood-water breeding species.

8. The survey, in addition, shows that the malaria vector, *Anopheles pseudopunctipennis*, does not exist in the Amazon Basin (as anticipated by Shannon, Davis, and Delponti, 1927) although it is known to occur, in company with *argyratarsis*, in the eastern Peruvian Andes at altitudes between 1,500 and 3,500 feet (Shannon, 1930).

II.

SPECIES OF ANOPHELINES FOUND IN THE AMAZON REGION.

PREVIOUS RECORDS OF ANOPHELINES FROM THE AMAZON REGION.

(Only publications in which specific names are given are listed.)

YR.	AUTHOR	SPECIES	PRESENT DESIGNATION	LOCALITY
1902	Durham	<i>Anopheles lutzii</i>	<i>A. (Stethomyia) nimbus</i> Th.	Manáos and Pará
1902	Durham	<i>Anopheles argyrotarsus</i>	? <i>A. (Nys.) darlingi</i> Root	Manáos
1904	Lutz	<i>Pyretophorus lutzii</i> Cruz	? <i>A. (Nys.) lutzii</i> Cr. <sup>3</sup>	Manáos
1904	Lutz	<i>Myzomyia lutzii</i> Theo.	? <i>A. (Nys.) cruzii</i> D. & K. <sup>3</sup>	Pará
1904	Lutz	<i>Cyclopeppterion mediopunctatum</i>	<i>A. (Arr.) mediopunctatus</i> Th.	Manáos
1905	Goeldi	<i>Anopheles argyrotarsis</i>	? <i>A. (Nys.) darlingi</i>	Pará
1905	Goeldi	<i>Anopheles argyrotarsis</i> var. <i>tarsimaculatus</i>	<i>A. (Nys.) tarsimaculatus</i> G.	Pará
1910	Newstead and Thomas	<i>Cellia argyrotarsis</i>	? <i>A. (Nys.) darlingi</i>	Amazon
1910	Newstead and Thomas	<i>Cellia albimana</i>	<i>A. (Nys.) tarsimaculata</i>	Manáos, etc.
1910	Newstead and Thomas	<i>Stethomyia nimba</i>	<i>A. (Steth.) nimbus</i>	Manáos
1921	Peryassu	<i>Stethomyia nimba</i>	<i>A. (Steth.) nimbus</i>	All from
1921	Peryassu	<i>Anopheles lutzii</i>	? <i>A. (Nys.) cruzii</i> <sup>4</sup>	Amazonas
1921	Peryassu	<i>Myzorrhynchella lutzii</i>	? <i>A. lutzii</i> <sup>4</sup>	and Pará
		<i>Cyclopeppterion mediopunctatum</i>	<i>A. (Arr.) mediopunctatus</i>	
		<i>Cyclopeppterion intermedium</i>	<i>A. (Arr.) intermedius</i> Ch.	
		<i>Cyclopeppterion maculipes</i>	? <sup>5</sup>	
		<i>Cyclopeppterion pseudomaculipes</i>	? <sup>5</sup>	
		<i>Cellia argyrotarsis</i>	? <i>A. (Nys.) darlingi</i>	
		<i>Cellia albimana</i>	? <i>A. (Nys.) bachmanni</i> Pet.	
		<i>Cellia tarsimaculatus</i>	<i>A. (Nys.) tarsimaculatus</i>	
1923	Christophers	<i>Anopheles amazonicus</i> Chr.	<i>A. (A.) mattogrossensis</i>	Amazon River
1926	Bequaert	<i>Anopheles amazonicus</i> Chr.	<i>A. (A.) mattogrossensis</i>	Rio Branco
1926	Bequaert	<i>Anopheles tarsimaculatus</i>	<i>A. (Nys.) tarsimaculatus</i>	Amazon Basin
1926	Bequaert	<i>Anopheles celidopus</i> D. & S.	<i>A. (A.) peryassui</i> D. and K.	Rio Branco
1931	Davis	<i>Anopheles tarsimaculatus</i>	Designation as given by author	All from Belém, Pará
		<i>Anopheles darlingi</i>		
		<i>Anopheles intermedium</i>		
		<i>Anopheles shannoni</i>		
		<i>Anopheles mediopunctatus</i>		
		<i>Anopheles nimbus</i>		

<sup>3</sup> These species, *lutzii* and *cruzii*, probably have not been found in the region since these 1904 records. They probably have a very localized distribution in the valley.

<sup>4</sup> Apparently based on Lutz' 1904 records.

<sup>5</sup> Of doubtful occurrence in the Amazon region.

## SPECIES COLLECTED DURING THE SURVEY.

SPECIES	LOCALITY
<i>An. nimbus</i> Theobald	Iquitos, Manáos, Sanatarem, Belém
<i>An. thomasi</i> Shannon <sup>6</sup>	Iquitos
<i>An. kompi</i> Edwards	Manáos
<i>An. mattogrossensis</i> Lutz and Nieva	Iquitos, Porto Velho, Abuna, Manáos, Boa Vista
<i>An. peryassui</i> Dyar and Knab	Iquitos, Porto Velho, Abuna, Manáos
<i>An. intermedius</i> Chagas	Iquitos (Belém, Davis)
<i>An. fluminensis</i> Root	Iquitos
<i>An. shannoni</i> Davis	Iquitos, Manáos, Belém
<i>An. mediopunctatus</i>	Iquitos, Guajara-Mirim, Manáos
<i>An. albitarsis</i> L. Arribalzaga	Abuna, Guajara-Mirim, Boa Vista
<i>An. darlingi</i> Root	Nazareth, Juhaty, Porto Velho, San Antonio, Abuna, Murtinho, Guajara-Mirim, Guayara-Mirim, Manáos, Boa Vista, Belém
<i>An. tarsimaculatus</i> Goeldi	Iquitos, Tonantins, Trapiche, Porto Velho, Guajara-Mirim, Manáos, Boa Vista, Belém
<i>An. strodei</i> Root	Abuna
<i>An. bachmanni</i> Petrocchi	Iquitos, Porto Velho, Guayara-Mirim, Manáos, Boa Vista

## III.

## GENERAL ACCOUNT OF THE DISTRIBUTION OF THE BRAZILIAN ANOPHELINES IN RELATION TO THE AMAZON VALLEY.

## I. CHARACTERISTICS OF THE AMAZON VALLEY.

It is evident that the great uniformity of climate and topography of the Amazon Basin makes it favorable only for certain species of anophelines. The species found here are therefore of unusual interest from the standpoint of distribution and ecology.

The following brief account dealing with the characteristics of the region is abstracted from Councilman and Lambert (1918):

The Amazon Valley is the largest area on earth which can be treated as a single unit in which practically the same conditions persist throughout. It includes approximately 2,000,000 square miles and is almost as flat as the sea. At Iquitos, Peru (2,300 miles from the mouth of the river), the altitude is but 315 feet. The basin is roughly delineated by the fall-lines on the north and south and by the Andes of the west.

The entire low region, which is subject to flooding, is known as the flood plain, and this is divided into the igapó and varzea. The igapó, really a swamp forest, is the lowest and is subject to tidal overflows in the eastern portion and to slight rises in the river in the upper part. The varzea is flooded only during high water. A third type of land, the terra firma, is still higher and is not subject to overflow.

<sup>6</sup> Originally described under the name *lewisi* Shannon (1931) from Bahia.



There are seasonal variations in the rainfall, producing a long wet and a long dry season, and between these there is a short wet and a short dry season. There is a general rise in the rivers from March to June. The rise in some places is enormous: 100 feet has been recorded at Manáos, although from 40 to 50 feet is the usual rise. The valley at times becomes a sea and travel through the forest by canoe is possible.

The largest forested area in the world exists here; the towns and cities are but mere specks. The rivers and tributary streams are so numerous that a vast area is readily accessible by boat. Extending from the rivers there are everywhere igarapes or canoe paths which pass long distances into the land.

From the standpoint of anopheline breeding, the igarapes, which are usually densely vegetated, and the flooding of the varzea are the most important features of the valley. It may be further observed that rock outcrops and subsequently rocky stream beds occur only very sporadically. Possibly in their vicinity anophelines other than the ones here recorded may occur.

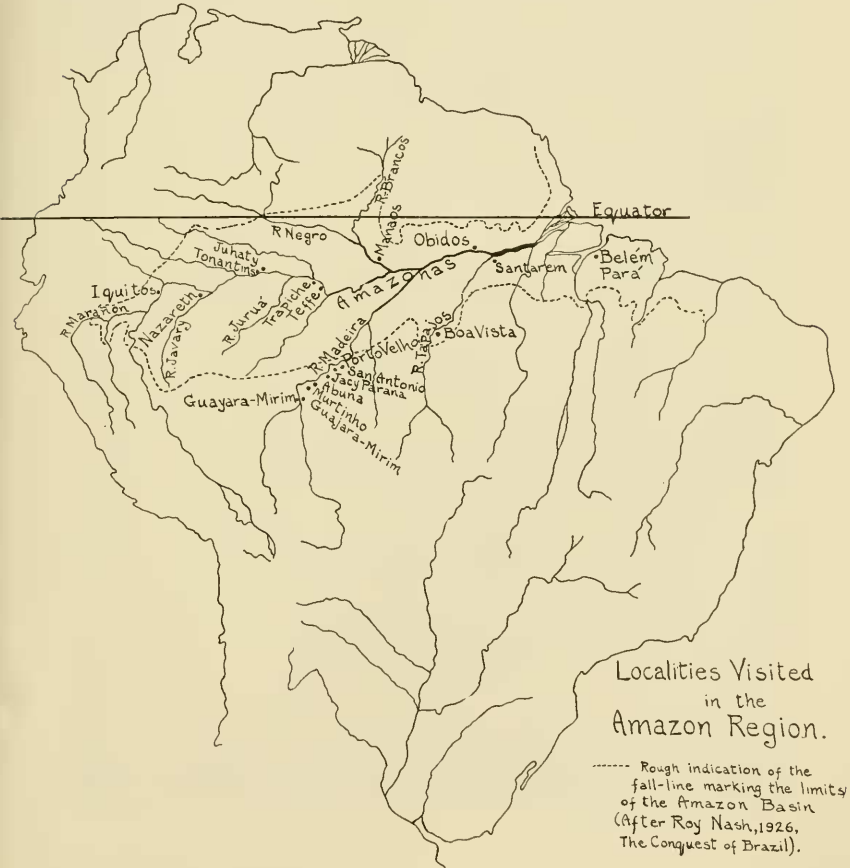


Fig. 1.

2. A GROUP SYSTEM OF THE BRAZILIAN ANOPHELINES AS BASED ON THE TYPE OF COUNTRY THEY INHABIT.

The anophelines of Brazil can be considered under four groups according to the type of breeding place or type of country in which they occur: (1) The upland-region group, which as far as is known breed in streams and rock pools; (2) the lowland forest, marsh, and swamp breeders; (3) the open country species (either upland or lowland); (4) the species inhabiting bromeliads.

These groups in turn conform remarkably well to the systematic grouping of the species as given in the latest classification (Edwards, 1932). The tabulation on page 122 indicates the general type of country inhabited by the different groups and subgroups, and the number of species of each group which were found in the Amazon region.

THE GROUPING OF BRAZILIAN ANOPHELINES ACCORDING TO THE TYPE OF COUNTRY THEY INHABIT.

GROUP	USUAL TYPE OF BREEDING PLACES	NO. OF BRAZILIAN SPECIES	NO. FOUND IN AMAZON REGION
Genus <i>Chagasis</i>	Upland regions, in fairly swift-flowing streams	1	0
Genus <i>Anopheles</i> Subgenus <i>Stethomyia</i> Subgenus <i>Anopheles</i>	Lowland forests	3	1
Group <i>Anopheles</i> a. Series <i>Anopheles</i> b. Series <i>Cyclolepteron</i>	Upland regions Lowland marshes and swamps	2 2	0 2
Group <i>Arribalzagia</i> Group <i>Arribalzagia</i>	Jungle pools Rocky stream breeder ( <i>An. minor</i> )	5 1 1	4 0 0
Subgenus <i>Nyssorhynchus</i> Group <i>Nyssorhynchus</i> Group <i>Myzorhynchella</i>	Open country, as a rule Upland regions, in small streams (? all)	9 3	5 0
Group <i>Kerteszia</i>	In forested regions with luxuriant growths of bromeliads	1	0
Subgenus <i>Myzomyia</i>	Open country (an African species, to date known only from the state of Rio Grande do Norte)	1	0

It will be noted that all of the species found during the survey are either typical of densely forested and lowland marsh and

swamp regions (*Stethomyia*, *Cyclopeppter*, *Arribalzagia*) or belong to the "open country" group of species (group *Nyssorhynchus*). Probably all of the former are generally distributed throughout the basin. Two of the latter group, *albitarsis* (typical form) and *strodei*, were found only at the periphery (fall-line) of the basin, where there is a perceptible change in the character of the country. However, a variety of *albitarsis*, *braziliensis*, was found in a small restricted locality near Manáos. The absence of the rather ubiquitous *An. argyritarsis* (another member of the *Nyssorhynchus* group) probably indicates, more than anything else, the strong relation existing between the nature of the region and its anopheline fauna.

The absence of certain species probably shows that factors other than the ones here indicated are also involved. Thus, larvae of *An. maculipes* of the group *Arribalzagia* have been found by Root on several occasions associated with larvae of *intermedius* in heavily shaded pools in or at the edge of low second growth jungle in the state of Rio de Janeiro. Davis (1933) states that *maculipes* and *intermedius* range together through the lowlands of the state of Rio de Janeiro; but whereas *intermedius* is found northward to the Amazon, *maculipes* has not been found even as far north as the state of Bahia.

It is very curious that no specimens of *Kerteszia*, a group addicted to breeding in the water contained in bromeliads, were found; in fact none appear to have been found since Lutz recorded *An. cruzii* from Pará (1904). Adults are easily attracted to animal bait and such bait was used wherever extensive collecting was done. But, although large terrestrial bromeliads were seen in some abundance at Iquitos, Porto Velho, and Manáos,<sup>7</sup> the arboreal types appeared to be rather sparse and of small size as compared with the luxuriant growth of these plants in other parts of the tropics.<sup>8</sup> It may be added that whereas in Panama the sabethines breeding in bromeliads form a large and characteristic portion of this country's mosquito fauna, they are rather poorly represented on the Amazon.

It is probable that some of the "upland" species (e. g. *Myzorhynchella*) occur within the limits of the basin where there chance to be hilly sections with rock bottom streams. In fact Lutz (1904) has recorded one of these, *An. (Myzorhynchella) lutzii* Cruz, from Manáos. In connection with this, it may be noted that water falls (Taruman Falls) exist not far from Manáos; likewise a small, rock-bottom stream is located on the outskirts of the city at the British club, the "Bosque." Search was made in this stream but no anopheline larvae were found.

<sup>7</sup> Many of these were examined.

<sup>8</sup> Dr. Lyman B. Smith, an authority on *Bromeliaceae*, in addition to informing me, by letter, that according to present knowledge the number of genera and species of the bromeliads is comparatively small in the Amazon Basin, adds, that in this region a high percentage of the plants are inhabited by ants, owing to the periodic flooding, and that such would be unfavorable for mosquito life.

## IV.

## ANOPHELES AND MALARIA IN AMAZONIA.

1. *An. darlingi* AND *tarsimaculatus*.

Published accounts (see pages 141 to 143) state that although malaria is generally prevalent throughout Amazonia, certain portions are much more afflicted than others. Particularly is it considered that the more dangerous portions occur along the tributary rivers, especially in the vicinity of their lowermost rapids.

General observations made during the survey suggest that this condition results from the fact that *An. darlingi*, in all probability the most dangerous vector in the region, apparently finds optimum breeding conditions in these tributary streams following the flooding of their valleys. The fact, too, that a number of the largest and more healthy cities and towns (Iquitos, Manáos, in part, Teffe, Itacoatiara, etc.) are located on high ground, the terra firma, and more or less well removed from the varzea and igapó levels, lends support to this observation. On the other hand, many of the smaller towns along the tributary rivers present a very decadent appearance, due in large part to malaria (see accounts of Iquitos, Nazareth, and Porto Velho given below).

Early authors, on circumstantial evidence, incriminated both *An. argyritarsis* and *An. tarsimaculatus* as the vectors. Doubtlessly the *argyritarsis* of these writers was *darlingi*, and to this extent they were correct in their views. Certain observations made upon *tarsimaculatus*, however, indicate that the species plays but a minor rôle in this region.

Davis (1931), on the basis of a series of dissections made at Belém, Pará, established the definite fact that *darlingi* is a malaria vector. He found a stomach infection rate of 22.3 per cent (197 specimens) and a gland rate of 9.5 per cent (181 specimens). Later, Davis and Kumm (1932) and Kumm (1932) demonstrated that this species is a vector in other parts of Brazil (Franca and Itapira, state of Bahia), and Benarroch (1931) has likewise found this species infected in nature in Venezuela. Furthermore the writer found at Porto Velho, Amazonas, a stomach infection rate of 9 per cent and a gland rate of 1.8 per cent in a series of 56 specimens. There can, therefore, be no doubt as to the importance of this species in connection with malaria.

Although *An. tarsimaculatus* seems to be much more common and ubiquitous in Amazonia than *An. darlingi*, and in fact, to be the commonest anopheline in this region, it would appear from circumstantial evidence to be of relatively little importance (see account under Iquitos). Moreover dissections of more than 400 specimens of this species made by different workers in

various parts of Brazil give an infection rate of only 0.8 per cent (including one gland infection, Boyd, 1926).

The following records show that *An. darlingi* is decidedly a house-haunting species while *An. tarsimaculatus* is rarely found indoors:

HOUSES VERSUS ANIMAL BAIT CAPTURES OF *An. darlingi* AND *An. tarsimaculatus*.

AUTHORS AND LOCALITY	SPECIES	HOUSE	ANIMAL BAIT
Davis (1931).....	<i>darlingi</i>	252	1
Belém, Pará.....	<i>tarsimaculatus</i>	24	138
Davis and Kumm.....	<i>darlingi</i>	250 <sup>9</sup>	80
(1932) Franca, Bahia.....	<i>tarsimaculatus</i>	0	172
Shannon, Amazonia.....	<i>darlingi</i>	800 <sup>9</sup>	74
	<i>tarsimaculatus</i>	1	1000 <sup>9</sup>

2. ANOPHELES ALBITARSIS.

Although *albitarsis* does not as a rule appear to be as domestic as *darlingi*, it will at times invade houses in fairly large numbers. Kumm (1932) records 423 specimens found in houses during less than a month's time at Salvador, Bahia, and from 240 of these a stomach infection rate of 5.8 per cent was obtained.

The fact that *albitarsis* occurs along the periphery of the Amazon Basin (Rio Madeira and Rio Tapajós) may to some extent complicate the malaria problem there.<sup>10</sup>

V.

LOCALITIES VISITED AND ANOPHELINES FOUND.

1. THE UPPER AMAZON REGION.

(1) *Iquitos and Vicinity*.—Iquitos, Peru, the third largest city (population about 18,000) in Amazonia, is situated mainly on the fairly high bank (50–75 feet above the river level) of the Rio Itaya near its junction with the Amazon. In the rear of the town, the ground slopes gradually to swamp land, which

<sup>9</sup> Approximate number observed.

<sup>10</sup> Dr. William Mann (Washington, D. C.) has supplied me with the following unpublished observations on *albitarsis* which are of interest owing to the proximity of the locality to the Amazon region. "At Lake Rocagua, northern lowlands of Bolivia, we found these mosquitoes so abundant that we would be driven out into the hot sunshine to get free of them. I ran a little fever while there. The region is thinly populated pampas country." Many specimens were collected and are now in the U. S. N. Museum collection. Neiva and Penna (1918) and other Brazilian observers have likewise observed swarms of this species attacking in sunlight.

begins about two miles distant. On the west is a fairly large lake, the Morona Cocha, which during the rainy season is partly surrounded with boggy ground. The vicinity of the town is rarely if ever flooded by river overflows, a fact which appears to be of great importance and which may account for the absence of *An. darlingi* in the captures made here. Local doctors and residents claim that although numerous persons with malaria arrive in Iquitos from highly malarious places in the general region, comparatively few secondary cases develop.<sup>11</sup> The section called Pijuayo Loma is considered to have some endemic malaria. No larvae however were found in the few bodies of water there, and in an evening capture only a few *An. tarsimaculatus* adults were taken.

## LIST OF ANOPHELINE SPECIES FOUND AT IQUITOS.

SECTION	CONDITIONS	SPECIES	NUMBER OF ADULTS CAPT'D	REMARKS
(1) Versailles and beyond to swamp	Open and forested country with field and forest streams, pools, marsh, swamp waters	<i>nimbus</i>	Moderate	Larvae in pooled woodland stream
		<i>matogrossensis</i>	Rare	One larva, open swamp
		<i>peryassii</i>	Few	Few larvae, open swamp
		<i>mediopunctatus</i>	Moderate	Larvae associated with <i>nimbus</i>
		<i>shannoni</i>	Few	
		<i>bachmanni</i>	Moderate	Larvae along edges of pond
(2) Morona Cocha	A fairly large open lake, partly surrounded by boggy ground	<i>mediopunctatus</i>	Few	
		<i>shannoni</i>	Rare	
		<i>bachmanni</i>	Few	
		<i>tarsimaculatus</i>	Few	
				Larvae in marsh
(3) San Juan	13 kilometers from Iquitos, densely forested, a few scattered clearings, large portions swampy, a few small streams, pools, but no open marshes.	<i>nimbus</i>	Many	Larvae in swamp water; a few males net-captured
		<i>thomasi</i>	Few	Four males collected
		<i>mediopunctatus</i>	Many	
		<i>intermedius</i>	Few	
		<i>fluminensis</i>	Few	
		<i>shannoni</i>	Few	One pupa in jungle swamp
		<i>bachmanni</i>	Moderate	
<i>tarsimaculatus</i>	Moderate			

<sup>11</sup> Councilman and Lambert (1918) state: "Malaria is said to be not common in Iquitos although there is much in the surrounding region. The official report for 1916 lists only eleven deaths from malaria. Why it is not common here is one of the many puzzling features of the disease." Thomas (1906) likewise states that Iquitos itself is comparatively free of malaria, although numerous cases come from neighboring river basins. Freyd (1930), however, lists Iquitos among the places highly afflicted with the disease.



Certain forested areas near San Juan were extremely dense, with only a twilight degree of illumination. In these areas *An. nimbus* and *An. mediopunctatus* were abundant; the other species were very scarce, although a pupa of *shannoni* was found in a swamp well within the heart of the forest.

It was also noted that although *nimbus* was collected throughout the day, its main flight occurred during the half hour preceding that of the other species. After the first specimens of *mediopunctatus* began to appear, the flight of *nimbus* was practically at an end. This observation has previously been made by Neiva and Penna (1918).

(2) *Nazareth, Peru*.—Nazareth is a small town situated on the notoriously malarious river Javary, which is part of the boundary between Peru and Brazil. Portions of the town site are subject to flooding.

Two brief stops were made here (March 19 and April 26), and on both occasions *An. darlingi* was found in houses. On the latter occasion about two-thirds of the houses were visited; some of these harbored approximately 100 specimens of *darlingi* each. In addition two *An. mattogrossensis* were captured indoors. No anopheline larvae were found during the brief search that was made.

Owing to trade stagnation, and doubtlessly to the malaria which is very evident here, the town appears to be on the verge of collapse. The people are moving elsewhere as opportunity permits.

(3) *Boa Esperanza, Amazonas*.—This is a recently built town at the mouth of the Javary, established in an attempt to provide a more healthful town site for the people farther up the river. Although the ground was partly flooded no anophelines were found in the houses; neither were there any observed on board the ship after dark.

(4) *Tonantins, Amazonas*.—On March 17, on board ship, while docked at Tonantins, between the hours of 11 p. m. and 2 a. m., two *An. tarsimaculatus* and two *An. mattogrossensis* were captured.

(5) *Jahaty, Amazonas*.—On April 28, one *An. darlingi* was found indoors at Jahaty.

(6) *Trapiche, Amazonas*.—At Trapiche, on March 13 and April 29, two *An. mattogrossensis* were taken on board ship and one *mattogrossensis* and a male *tarsimaculatus* indoors.

## 2. ANOPHELINES FOUND ALONG THE MADEIRA AND MAMORÉ RIVERS.

(1) *Porto Velho, Amazonas*.—This is the largest town on the Rio Madeira. It is situated at the head of navigation and is the base for the Madeira-Mamoré railroad. It has a long and bitter malaria history. Two large areas within the town limits as well as several small ones were flooded at the time of my visit (May 10–16). In addition to the town area, a number of flooded

areas on both sides of the railroad beyond the town limits were examined. In comparison with the number of anopheline adults that could be captured, larvae appeared to be scarce. The captures made are summarized below.

ANOPHELINE LARVAE AND ADULT CAPTURES AT PORTO VELHO, AMAZONAS.

CONDITIONS	SPECIES	NUMBER OF SPECIMENS
Small flooded area within city limits.....	<i>darlingi</i>	10 larvae, 1 pupa
Large flooded area within city .....	<i>tarsimaculatus</i>	22 larvae
Flooded areas beyond city limits.....	<i>darlingi</i> <i>tarsimaculatus</i>	9 larvae 20 larvae
Houses in native quarter.....	<i>darlingi</i>	5 adults
Houses in West Indian (negro) quarter...	<i>darlingi</i>	154 adults
Scattered houses beyond town limits .....	<i>darlingi</i>	21 adults
(see No. 3)		
Animal bait near native quarter.....	<i>tarsimaculatus</i>	73 adults
(No. 4)	<i>darlingi</i> <i>peryassui</i>	32 adults 1 adult
Animal bait near West Indian quarter ..	<i>tarsimaculatus</i>	106 adults
(No. 5)	<i>darlingi</i>	2 adults

Fifty-six of the *darlingi* collected in houses were dissected; five of them had oöcysts and one of these had sporozoites as well. The rate of infection was 8.9 per cent.

(2) *Santo Antonio, Amazonas*. This town is located practically on the fall-line of the Amazon Basin. The S. Antonio Falls of the Madeira River are close by. Very little standing water was seen (extensive drainage was accomplished here during the construction days). Six *An. darlingi* were found in ten houses visited (May 13).

(3) *Open Swamp Area near Porto Velho, Matto Grosso*.—During a brief stop at an open swamp area along the railroad about 175 kilometers southwest of Porto Velho, Matto Grosso, on May 18, at dusk a few *An. albitarsis* and *peryassui* attacked us.

(4) *Abuna, Matto Grosso*.—On May 19 and 21, ten houses were examined at Abuna, Matto Grosso, but only one *An. darlingi* was found. Several large ground pools had rather numerous *An. tarsimaculatus* larvae. Several *An. strodei* larvae were found in a borrow pit.

(5) *Murtinho, Matto Grosso*.—Sixteen *An. darlingi* were found under a mosquito bar in the restaurant-house at Murtinho on May 19.



(6) *Guajara-Mirim, Matto Gross.*—This town is at the rail-head, 365 kilometers from Porto Velho. The ground surface is very rocky. The following captures were made with animal bait (May 19): *An. tarsimaculatus* (in part? *strodei*), 160; *darlingi*, 27; *bachmanni*, 24; *albitarsis*, 2; *mediopunctatus*, 2.

(7) *Guayara-Mirim, Bolivia.*—This town is situated across the Rio Mamoré just opposite Guajara-Mirim, Matto Gross. There are large flooded areas along the river. No larvae were found during the short investigation made, and only one house in six was found to harbor adult *darlingi*.

3. MANÁOS, AMAZONAS, RIO NEGRO, JUNE 1-11.

The presence of four igarapes extending through the city of Manáos gives the impression that mosquito breeding should be very prolific. However, as the following records show, collections proved to be much smaller here than in most of the other places visited. Even in the suburbs only small numbers of mosquitoes were captured.

ANOPHELINES COLLECTED AT MANÁOS, AMAZONAS.

SOURCE	SPECIES	NUMBER OF SPECIMENS
Park Fountains, center of town.....	<i>tarsimaculatus</i>	20 larvae
Igarape Manáos.....	<i>tarsimaculatus</i>	Larvae fairly abundant
Twelve houses along igarape.....	No anophelines	
Animal bait near igarape.....	<i>tarsimaculatus</i> <i>bachmanni</i>	54 1
Igarape São Raymundo.....	<i>tarsimaculatus</i>	Few larvae
Ten houses.....	<i>darlingi</i>	7
Animal bait.....	<i>darlingi</i> <i>tarsimaculatus</i> <i>bachmanni</i> <i>mattogrossensis</i>	4 4 1 1
Outskirts of town, on animal bait....	<i>nimbus</i> <i>kompi</i> <i>tarsimaculatus</i> <i>bachmanni</i> <i>shannoni</i>	5 2 14 3 2
Flores.....	<i>albitarsis</i> - <i>brasiliensis</i> <sup>12</sup> <i>mediopunctatus</i> <i>shannoni</i> <i>peryassui</i>	7 1 5 5

<sup>12</sup> This is the only locality within the basin proper where this form was found. The numerous shallow open marshy areas about Flores represent an unusual type of land for the Amazon Valley.

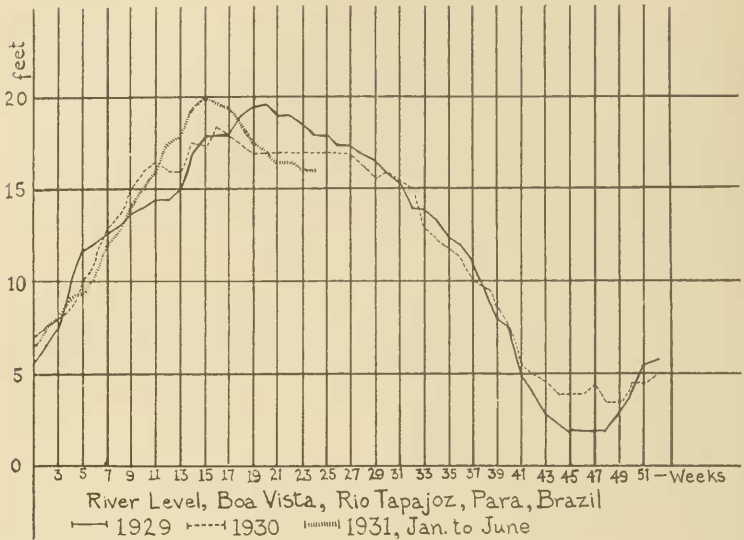


Fig. 2.

## 4. BOA VISTA, RIO TAPAJÓZ, PARÁ, JUNE 14-19.

Boa Vista, headquarters of the Companhia Ford Industrial of Brazil at Fordlandia, is situated 120 miles up the Rio Tapajoz. It lies not far from the fall-line as the San Luis rapids are about 70 miles farther up the river. The general region consists largely of rough hilly country, and streams are fairly numerous. But in spite of its upland features none of the species belonging to the "upland" group of anophelines were found. The fact that the area is in some respects different from the main portion of the basin is indicated by the presence of *An. albitarsis*.

Fordlandia is probably the first extensive section in Amazonia to undergo rapid, large-scale plantation clearings. It will be important to note the effect that this will have upon anopheline breeding, but meanwhile efforts are being made to control the situation in whatever direction it may develop. During the brief investigations made here larvae of both *tarsimaculatus* and *darlingi* were found in situations formerly under forest cover.

Although adult *An. darlingi* were collected in six localities in Fordlandia, the species was not found as abundantly as at Porto Velho and Nazareth. Climatic records supplied by the manager of the plantation shows that in 1931 the river level had reached its maximum height during April and that at the time of my visit (middle of June) the river had fallen approximately four feet. It is probable therefore that the breeding of this species was on the decline. Moreover, the laboratory records furnished me by Dr. Claude Smith show that the peak

of malaria infections had been attained during the month of May. Extensive oiling at Boa Vista and nearby towns had checked the breeding at these sites. Elsewhere, however, comparatively few favorable breeding places for *darlingi* were found, although larvae of *tarsimaculatus* and *bachmanni* were fairly abundant. The following captures were made:

1. Boa Vista. In screened houses. Two *An. bachmanni*, biting man.

2. Adults collected on animal bait stationed at a small shallowly flooded grassy field at the river's edge: *An. darlingi*, 1; *albitarsis*, 19; *tarsimaculatus*, 5; *bachmanni*, 248; *mattogrossensis*, 3.

3. A partially flooded ravine, the upper part recently cleared of forest cover, the remainder open marsh land reaching to the river's edge; situated behind the town. Larvae: *An. darlingi*, 2; *tarsimaculatus*, 70; *bachmanni*, 49; *mattogrossensis*, 12.

4. Animal bait capture made near the ravine: *An. albitarsis*, 1; *tarsimaculatus*, 14; *bachmanni*, 68; *mattogrossensis*, 2.

5. Stream at edge of forest cover (near the seed-bed). Ground rather low, partly flooded during the rainy season. On this date (June 15, 1931) parts of the stream had a fairly swift current. Adults captured on animal bait: *An. darlingi*, 9; *tarsimaculatus*, 212; *bachmanni*, 29; *mattogrossensis*, 11.

6. Farm section, about five miles below Boa Vista. Considerable drainage had been effected here, and ditches and standing water were oiled weekly. Only scattered *bachmanni* larvae were found.

7. Native village, about one-half mile below the farm. River bank well flooded but rather heavily shaded by trees. Larvae very scarce, only two *tarsimaculatus*; and one *mattogrossensis* were found. The water at the river's edge was literally swarming with a small species of *Corixidae*, probably a predator on mosquito larvae. In the houses, however, fourteen *An. darlingi* were found.

8. Tabacal, a native town about three miles above Boa Vista. Forty *An. darlingi* were found in houses; twenty were collected in a single house. In addition, two *albitarsis* and one *mattogrossensis* were found indoors. Larvae found in an open, flooded area along the town; *darlingi*, 2; *tarsimaculatus*, 5; *bachmanni*, 3. In the flooded area along the river: *tarsimaculatus*, 3.

9. Sumuhuma, a small town across the river from Boa Vista. A sharp outbreak of malaria occurred here during the preceding months, April and May. At this time a large flooded area existed in the rear of the town, but at the time of my visit drainage operations were about completed, and but little stagnant water could be found. Two *An. darlingi* and eleven *An. tarsimaculatus* larvae were collected, while indoors fourteen *darlingi* adults were found.

## VI.

## KEY TO THE AMAZON SPECIES OF ANOPHELES.

## ADULT FEMALES.

1. Integument of the mesonotum with a median longitudinal white line; antennal hairs as long as width of thorax; wing scales and legs entirely dark.....Subgenus *Stethomyia*.....2
- Integument of the mesonotum without a median white line; antennal hairs much shorter than width of thorax.....3
2. White spot at vertex of head composed of normal scales which do not overhang the basal antennal segments.....*kompfi* Edwards
- This spot composed of silvery-white, scale-like setae which project forward and overhang the basal antennal segments.....  
*nimbus* Theobald and *thomasi* Shannon
3. Second, fourth, and sixth veins without white scales; abdomen without scales; hind tarsals black, with two to four white bands or rings.....  
Subgenus *Nyssorhynchus* (in part) Group *Kerteszia*, *cruzei* Dyar and Knab<sup>13</sup>  
These veins with light colored areas.....4
4. Third and fourth hind tarsals white; sixth vein with two dark scaled areas.....Subgenus *Nyssorhynchus* 5
- Third and fourth hind tarsals black, or with black markings; sixth vein with four or more dark spots.....Subgenus *Anopheles* 10
5. Abdomen without scales save on eighth segment and cerci; third wing nearly all dark. Group *Myzorhynchella*, *lutzi* Cruz.<sup>14</sup>  
Abdomen scaled on tergites 2-8, usually with lateral scale tufts.....  
Group *Nyssorhynchus* 6
6. Fifth hind tarsal white.....7
- Fifth hind tarsal with black ring.....9
7. First abdominal sternite with two longitudinal lines of white scales; first black spot of costa much smaller than succeeding white spot; second hind tarsal one-third to one-half black; eighth abdominal segment distinctly longer than broad and extensively covered with light scales above.
8. First black spot of costa longer than succeeding white spot; second hind tarsal one-third or more black.....*darlingi* Root
- The size of these spots reversed; second hind tarsal usually less than one-third black.....*argyritarsis* Rob. Desv.<sup>15</sup>
9. First black spot on costa equal to or greater than the succeeding white spot; second hind tarsal over one-third black; specimens usually of small size.....*bachmanni* Petrocchi
- First black spot on costa smaller than the succeeding white one; second hind tarsal usually not more than one-fourth black; specimens usually of moderate size.....*tarsimaculatus* Goeldi and *strodei* Root

<sup>13</sup> Recorded but once from Amazonia, Lutz, Pará, 1904.<sup>14</sup> Recorded but once from Amazonia, Lutz, Manáos, 1904.<sup>15</sup> Not found but probably occurs in the vicinity of the periphery of the basin.

10. Abdomen without lateral scale tufts; legs without light markings save at articulations of segments...Group *Anopheles*, Series *Cyclolepteron*...11  
 Abdomen with lateral scale tufts; legs usually with numerous light markings.....Group *Arribalzagia*<sup>6</sup>.....12
11. Black and white wing markings strongly contrasted; last abdominal tergite and cerci clothed with scales; thorax bluish gray with three black spots; rather small species.....*peryassui*, Dyar and Knab  
 Light wing markings brownish yellow; the general effect of the wing as well as the entire insect is dull brown; abdomen with scales only along the middle line of the sternites; mid-mesepimeral setae present; rather large species.....*mattogrossensis* Lutz and Neiva
12. Wing scales linear, three times as long as broad or longer.....13  
 Wing scales, particularly on basal portion of wing, broad, the length less than three times the width.....14
13. Small species; last four hind tarsals black with small white rings at the apices of segments; haltere small with white scales only on basal portion; without scales on first abdominal sternite; posterior marginal wing scales begin near the wing base.....*minor* Costa Lima<sup>17</sup>  
 Large species; the hind tarsals with additional light markings; haltere well expanded, profusely white scaled; first abdominal sternite with two small patches of scales; posterior marginal wing scales begin well before middle of anal cell.....*maculipes* Theob.<sup>17</sup>
14. Hind tarsals black with small white rings at apices of segments; abdomen with a conspicuous light tip, the cerci usually well extruded, each with the apical half strongly constricted; wing scales predominately black; post-marginal wing scales beginning well before the middle of the anal cell .....*shannoni* Davis  
 Hind tarsals with additional light markings; tip of abdomen predominantly dark, the cerci normal.....15
15. Last hind tarsal entirely light colored; dark spot at tips of second vein about the size of that at tip of first vein; post-marginal wing scales begin at about middle of anal cell.....16  
 Last hind tarsal at least in part black; without scales on mesepimeron; wing scales moderately dilated.....18
16. Wing scales moderately dilated; without scales on mesepimeron or first abdominal sternite; mid femur on upper side with a small (less than width of femur) preapical white spot.....  
*punctimacula* Dyar and Knab.  
 Wing scales markedly dilated, about one-half as broad as long; mesepimeron with a small patch of scales on upper portion.....17
17. Fourth hind tarsal with one black ring; mid femur with lateral apical light spots (upper side black); first abdominal sternite with two small

<sup>16</sup> In the course of this study certain characters heretofore unused in the group *Arribalzagia* appeared to offer additional means for classifying this difficult group. I am supplementing the old characters with these, but they should be regarded as tentative until tested by large numbers of specimens. In order to extend their application as much as possible at the present time species of *Arribalzagia* have been included in the table.

<sup>17</sup> Species not found in the Amazon Region.

- patches of white scales; lateral scale tufts of the abdomen composed of yellow and black scales ..... *mediopunctatus* Theob.
- Fourth hind tarsal with two black rings; mid femur, on upper side, with a fairly large white spot (the sides black); first sternite bare; lateral abdominal tufts black, white scales sporadically present.....  
*fluminensis* Root
18. Post marginal wing scales begin well before the middle of the anal cell; wing scales but little dilated..... *apicimacula* Dyar and Knab<sup>18</sup>
- Post-marginal wing scales begin at about the middle of the anal cell; wing scales moderately dilated..... 19
19. Tips of wing scales rounded; dark spot at the wing apex about the size of the preceding one ..... *punctimacula* Dyar and Knab.
- Tips of wing scales truncate; dark spot at wing apex decidedly larger than the preceding one..... *intermedius* Chagas

## VII.

## SYSTEMATIC NOTES ON CERTAIN SPECIES.

## I. LARVAE OF THE SPECIES OF THE SUBGENUS STETHOMYIA.

Davis (1933) has described and compared the larva of *An. thomasi* with that of *An. kompi*. Important features of the larva of *nimbus* from Iquitos are herein figured. The following key gives the more obvious differences of the three species:

1. Inner hair of the anterior submedian thoracic group with three short apical branches, or simple..... *thomasi*  
This hair with six or more branches (about six in *kompi*; fourteen in *nimbus*)..... 2
2. Antenna with a small two-or-three-branched hair basad of the middle.....  
*kompi*  
Antenna with a four-branched hair at or slightly beyond the middle.  
Float hairs slightly more apparent than in *kompi* with 8 (1st segment), 12 (2d), 18 (3d) branches..... *nimbus*

Edwards (1930, 1932) in describing the pleural hairs of the larva of *nimbus* states "One of the three long hairs in the prothoracic pleural groups with a series of short spine-like branches along one side." His description was based on specimens from Venezuela. The specimens at hand from Iquitos, however, have this hair developed as described for *kompi* by Root (1932), namely without spines but strongly feathered. The male terminalia of *nimbus* from Iquitos, however, agrees with the figure given by Edwards for this species as based on a specimen from Venezuela.

<sup>18</sup> *Anopheles (Anopheles, Arribalzagia) neomaculipalpus* recently described by Curry (1931) from Panama is said to differ from *apicimacula* and *punctimacula* by having only two large spots on the costa instead of three, which is characteristic of the other two species.



2. *Anopheles (Cyclolepteron) mattogrossensis* Lutz and Neiva, 1911.  
(= *Anopheles (Anopheles) amazonicus* Christophers, 1923.)

Three specimens of *mattogrossensis* were compared with the types of *amazonicus* at the Liverpool School of Tropical Medicine by Dr. Alwen Evans, who writes, "The type and paratype of *amazonicus* are by no means in perfect condition, but the only definite difference I can see is the longer forked cell in the former, being about one-third of the wing length in *amazonicus* but not much more than a quarter in *mattogrossensis*." A series of fifty specimens of *mattogrossensis*, however, shows that the length of the upper forked cell varies from 29 to 36 per cent of the wing length, the average being about 32 per cent.

Dyar (1928) suggests that *mattogrossensis* may be a form of *vestitipennis* differing somewhat in color markings. Dr. Alan Stone, however, informs me that the mid-mesepimeral setae which characterize the former are absent in *vestitipennis* (twenty specimens examined). *Mattogrossensis* therefore should be regarded as a distinct species. Apparently it is the only American species possessing mid-mesepimeral setae.

Two pupae were procured, but unfortunately only females emerged. A number of larvae were found. As this stage is as yet undescribed the following is given:

Larva of *An. mattogrossensis*.—Hair at tip of antenna consisting of a single main stem and with small branches uniformly distributed; antennal shaft hair located basad of the middle, very large, the tips extending beyond the apex of the shaft, with about ten branches, outer clypeals thinly branched, each with thirty-five to forty ultimate branches; post clypeals small but with ten to twelve branches; innermost hairs of the anterior submedian thoracic group palmate-like, with ten branches; posterior angle of the thorax with a rudimentary palmate hair; propleural hair group consisting of one short and three long simple hairs; meso- and metapleural groups each with two long simple hairs; abdomen with the full set of palmate hairs, those on segments one and two rather small; segment four with a long lateral two-branched hair, that on segment five two to three branched, the corresponding hair on segment six small, simple; pecten consisting of about sixteen teeth, without marginal hairs.

The double long lateral hairs on segments four and five possibly indicate a relationship with *An. vestitipennis* (Root 1929), but the palmate hairs on the anterior margin of the thorax is an unusual feature for the tropical American species of the subgenus *Anopheles*.

3. *Anopheles (Cyclolepteron) peryassui* Dyar and Knab 1908.

*Anopheles celidopus* Dyar and Shannon, 1925.

*Anopheles alagoanii* Peryassú, 1925.

In the discussion dealing with *peryassui*, *celidopus*, and *alagoanii* by Shannon and Davis (1930), it was pointed out that the last two may be homonyms of the first. Inasmuch as the

females and a male of "*celidopus*" (originally described from the Amazon region) collected at Iquitos agree in all essentials with *pervassui* from Bahia, as described by Shannon and Davis, there can no longer be any doubt regarding the homonyms as given above.

#### 4. *Anopheles* (*Arribalzagia*) *fluminensis* Root, 1927.

The description of this species was based on two males, reared from larvae found along the edge of a small brook at Itaperuna, Rio de Janeiro. Costa Lima (1929) has recorded two females, one from Goyaz, and the other from São Paulo. In addition to the possession of the white fifth hind tarsal segment, he adds that it may be distinguished from *mediopunctatus* by the color of the scales forming the lateral tufts of the abdomen (see key).

Twelve females which agree with the descriptions of *fluminensis* were collected on animal bait at San Juan, Iquitos. They are quite distinct from other members of *Arribalzagia*, and therefore there should be little doubt regarding the present designation.

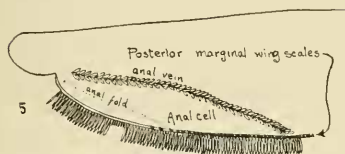
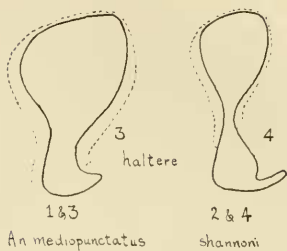
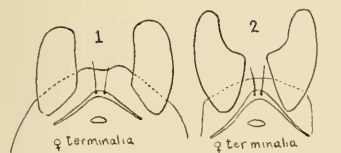
#### 5. *Anopheles* (*Arribalzagia*) *Shannoni*, Davis (1931).

Only the female of this species has been described. A single pupa was found in the heart of a forest swamp at San Juan, Iquitos, from which a male was reared. It is therefore possible to add two more stages to the knowledge of this species. In addition, 20 females were collected at various points along the Amazon, but chiefly at Iquitos.

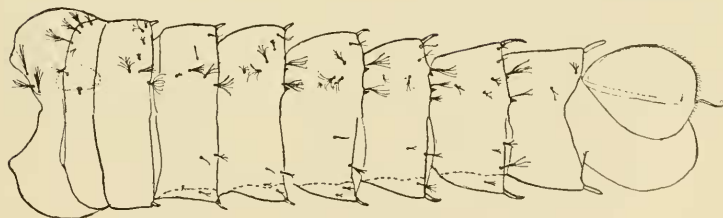
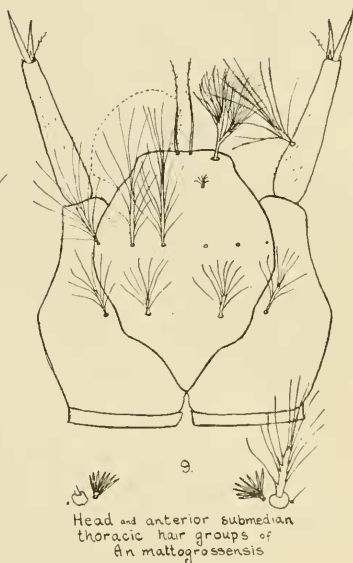
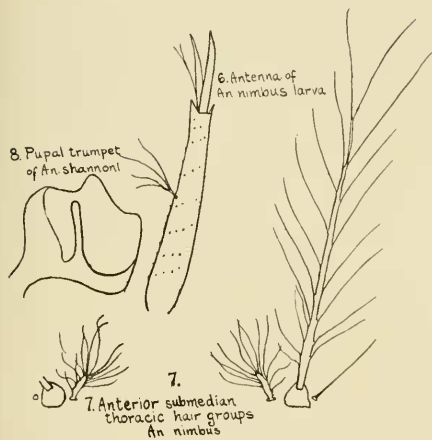
This is the only American anopheline in which the cerci of the female departs strikingly from the palpus-like form common to the genus, a condition possibly correlated with the "flash-color" tip of the abdomen. The abdomen is black except that the eighth tergite and the cerci are conspicuously light-scaled. The cerci are broadened at the middle and taper rather sharply towards the apex (Figure 2, Plate 4).

Terminalia of the male.—Ninth tergite with the usual pair of small, lobe-like processes; inner basal spine with curved tip, the outer straight, rather slender, less than twice the length of the inner (a little longer and heavier than the internal spine); claspette much wider than high, with a median incision, consequently a pair of ventral lobes, each rather uniformly clothed with short hairs and each bearing a single marginal spine and the usual club-like set of three spines which stand on a prominent tubercle; phallosome with a set of seven to eight leaflets on each side at tip, all of similar shape and graduating very uniformly in size from the upper one, which is about two-thirds the length of the phallosome, to the lowermost one which is very minute.





5 Location of the posterior marginal wing scales



10. Abdomen of the pupa of *Anopheles shannoni*. Dorsal and ventral aspects

The short outer basal spine (less than twice the length of the inner), the similarity in form of the leaflets on the phallosome, and the single spine on the claspette shows a similarity to the terminalia of *An. peryassui* (note also that the tarsal markings of these two species are similar); but the presence of the inner spine on the side piece definitely places the species in the *Arribatzagia* group (as also do the inflated wing scales, abdominal scale tufts, and the white scaled upper surface of the halteres).

*The pupa.*—The salient features of the pupa are: the finger-like process extending across the opening of the pupal trumpet (fig. 8); the short spine-like projections on segments 4-7 (fig. 10); the short hairs on the hind margins of the segments 4-7, equal to but one-half the length of their segments; and the simple condition of the spines on the eighth segment.

#### VIII.

#### RAINFALL RECORDS IN THE AMAZON BASIN.

The records for the first five stations were obtained from the Weather Bureau (Washington, D. C.) through the kindness of Mr. W. W. Reed. Those for Boa Vista and Parintins were supplied by the Companhia Ford Industrial do Brazil through the kindness of Mr. C. Rogge.

MEAN MONTHLY AND ANNUAL PRECIPITATION OF CERTAIN STATIONS IN THE AMAZON BASIN.

LOCALITY	YEARS OBS.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JUL.	AUG.	SEPT.	OCT.	NOV.	DEC.	YEAR
Iquitos, Peru.....	? 1	261	250	310	170	254	118	167	117	221	182	213	290	2623
Manáos, Amazonas.....	15	240	255	235	231	172	111	66	30	50	114	130	210	1819
Porto Velho, Amazonas.....	6	431	360	455	234	128	40	15	53	80	213	286	406	2682
Belém, Pará.....	29	294	330	380	310	240	170	157	113	84	70	68	152	2362
Boa Vista, Pará.....	1 (1929)	385	398	384	373	190	153	45	24	44	8	183	161	2353
Boa Vista, Pará.....	1 (1930)	165	265	306	236	187	175	61	28	7	20	89	190	1729
Parintins, Amazonas.....	1 (1930)	208	246	142	182	84	55	46	8	96	2	50	167	1285

## SUMMARY.

During a general mosquito survey made in the Amazon Basin, March to June, 1931, fourteen species of *Anopheles* were found, namely *nimbus* Theo., *thomasi* Shannon (*lewisi* Shan.), *kompfi* Edwards, *mattogrossensis* Lutz and Neiva (*amazonicus* Christophers), *peryassui* Dyar and Knab (*celidopus* Dyar and Shannon, *alagoani* Pery.), *mediopunctatus* Theo., *fluminensis* Root, *intermedius* Chagas, *shannoni* Davis, *darlingi* Root, *bachmanni* Petrocchi, *tarsimaculatus* Goeldi, *strodei* Root, *albitarsis* L. Arr.

It is shown that the species of anophelini of Brazil, as a whole, can be grouped according to the general type of region they inhabit, as (1) upland species, (2) lowland marsh, swamp, and jungle species, (3) open country, either upland or lowland species, (4) species breeding in bromeliads in forested country. This grouping is in harmony with the systematic group classification of the tribe. All of the species found during the survey belong to groups (2) and (3), which is largely to be expected in view of the nature of the Amazon region. Two species, *strodei* and *albitarsis*, however, were found only at the periphery (fall-line) of the basin, although a variety of the latter, *brasiliensis*, was found at Manáos. The most surprising omission from the list is *argyritarsis*, one of the commonest and most widely distributed of the South American species. One species belonging to group (1), *An. lutzii* Cruz, and one of group (4), *An. cruzii* Dyar and Knab, have been recorded from the region, both by Lutz in 1904. It is believed that the former may have a localized distribution in the valley in the vicinity of hilly sections, where such occur, and that the rarity of the latter may be due to an insufficient development of the bromeliad flora of the region.

*An. darlingi* appears to be by far the most dangerous malaria vector and was found practically throughout the region, from Belém (near the mouth of the river) to Peru and also on the northern border of Bolivia. It appears to be primarily a flood-water breeding species, and its absence in towns of sufficiently high elevation to be free of flooding (e. g. Iquitos) may thus be accounted for. This, in turn, may account for the comparative lightness of malaria in certain of the Amazonian towns. The presence of *An. albitarsis* along the periphery of the basin may complicate the malaria problem there.

Lists of captures made at each point are given, likewise a key of the species found in the region.

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Certain publications, marked with an \*, which contain information of unusual interest regarding malaria in Amazonia, are included, with brief notes dealing with their contents.

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